Velosti N-channel 650V, 7A, 0.57Ω Power MOSFET

Description

Velosti Power MOSFET is fabricated using advanced super junction technology. The resulting device has extremely low on resistance, making it especially suitable for applications which require superior power density and outstanding efficiency.

Features

- Ultra low $R_{DS(on)}$
- Ultra low gate charge (typ. Q_g = 19nC)
- 100% UIS tested
- RoHS compliant

Product Summary

V_{DS} @ $T_{j,max}$	700V
$R_{DS(on),max}$	0.57Ω
I_{DM}	21A
$Q_{g,typ}$	19nC
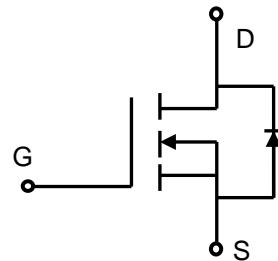
N-Channel MOSFET

Absolute Maximum Ratings

Parameter	Symbol	VSQ65R57B2	Unit
Drain-Source Voltage	V_{DS}	650	V
Continuous drain current (T_C = 25°C)	I_D	7	A
(T_C = 100°C)		4.4	A
Pulsed drain current [1]	I_{DM}	21	A
Gate-Source voltage	V_{GS}	$\pm$30	V
Avalanche energy, single pulse [2]	E_{AS}	230	mJ
Avalanche energy, repetitive [1]	E_{AR}	0.5	mJ
Avalanche current, repetitive [1]	I_{AR}	7	A
Power Dissipation (T_C = 25°C)	P_D	83	W
- Derate above 25°C		0.67	W/°C
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	°C
Continuous diode forward current	I_S	7	A
Diode pulse current	$I_{S,pulse}$	21	A

Thermal Characteristics

Parameter	Symbol	VSQ65R57B2	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.5	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62	°C/W

Package Marking and Ordering Information

Device	Device Package	Marking
VSQ65R57B2	TO-220	VSQ65R57B2

Electrical Characteristics T_c = 25°C unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV_{DSS}	V_{GS}=0 V, I_D=0.25 mA	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=0.25mA	2.5	3.5	4.5	V
Drain cut-off current	I_{DSS}	V_{DS}=650 V, V_{GS}=0 V,				µA
		T_j = 25°C	-	-	1	
		T_j = 125°C	-	10	-	
Gate leakage current, Forward	I_{GSSF}	V_{GS}=30 V, V_{DS}=0 V	-	-	100	nA
Gate leakage current, Reverse	I_{GSSR}	V_{GS}=-30 V, V_{DS}=0 V	-	-	-100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=3.5 A	-			Ω
		T_j = 25°C	-	0.51	0.57	
		T_j = 150°C	-	1.2	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.4	-	Ω
Dynamic characteristics						
Input capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V,	-	710	-	
Output capacitance	C_{oss}	f = 1 MHz	-	470	-	pF
Reverse transfer capacitance	C_{rss}		-	6	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 300V, I_D = 3.5A	-	16	-	
Rise time	t_r	R_G = 12Ω, V_{GS}=10V	-	13	-	ns
Turn-off delay time	$t_{d(off)}$		-	35	-	
Fall time	t_f		-	7	-	
Gate charge characteristics						
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=3.5A,	-	4	-	
Gate to drain charge	Q_{gd}	V_{GS}=0 to 10 V	-	9	-	nC
Gate charge total	Q_g		-	19	-	
Gate plateau voltage	$V_{plateau}$		-	5.8	-	V
Reverse diode characteristics						
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=3.5A	-	-	1.2	V
Reverse recovery time	t_{rr}	V_R=50 V, I_F=7A,	-	290	-	ns
Reverse recovery charge	Q_{rr}	dI_F/dt=100 A/µs	-	3.4	-	µC
Peak reverse recovery current	I_{rrm}		-	14	-	A

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature

2. I_{AS} = 2.5A, V_{DD} = 60V, R_G = 25Ω, Starting T_J = 25°C

Electrical Characteristics Diagrams

Figure 1. On-Region Characteristics
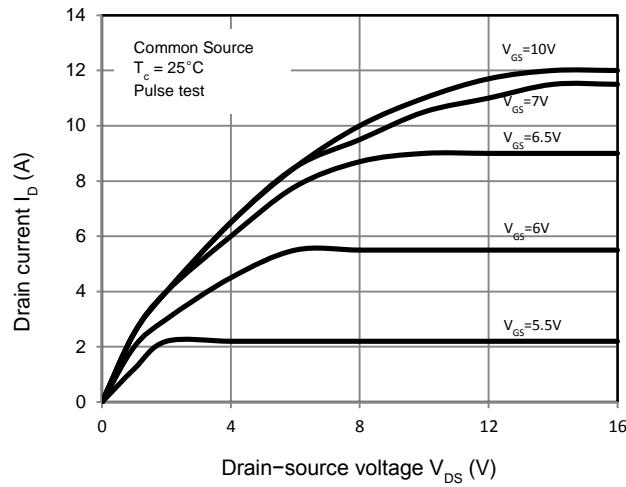
Figure 2. Transfer Characteristics
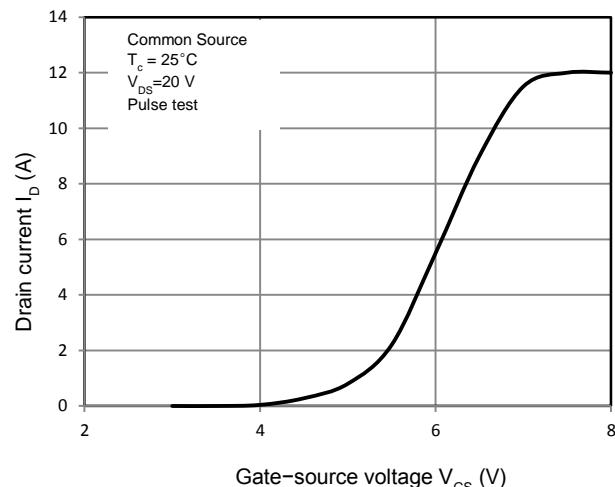
Figure 3. On-Resistance Variation vs. Drain Current
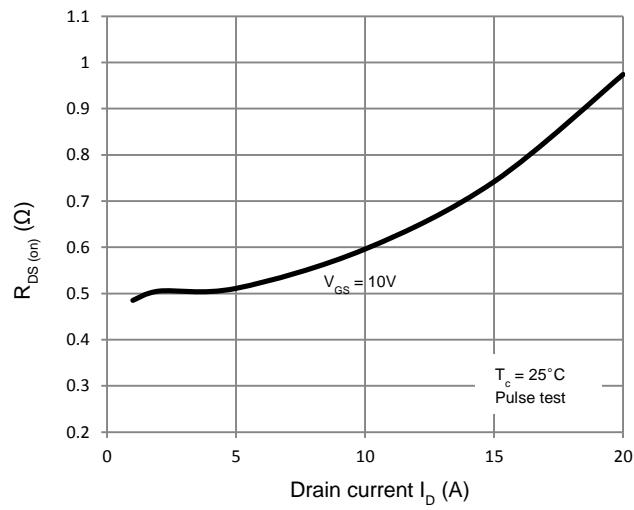
Figure 4. Threshold Voltage vs. Temperature
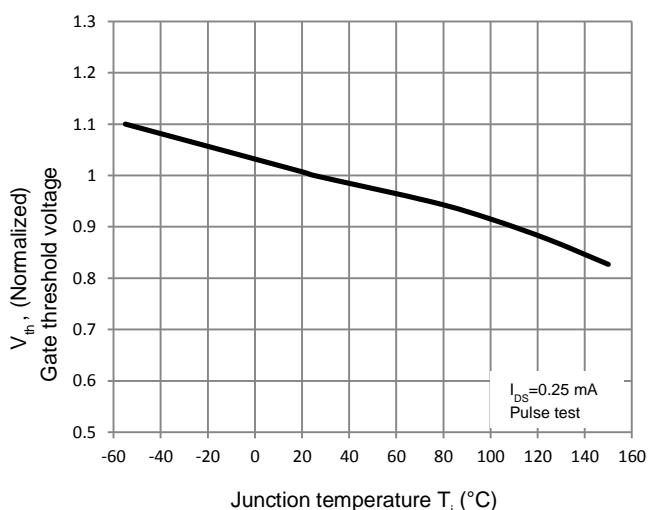
Figure 5. Breakdown Voltage vs. Temperature
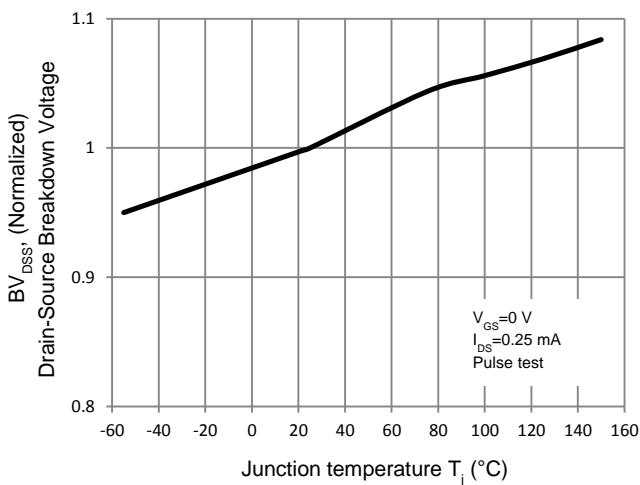

Figure 6. On-Resistance vs. Temperature
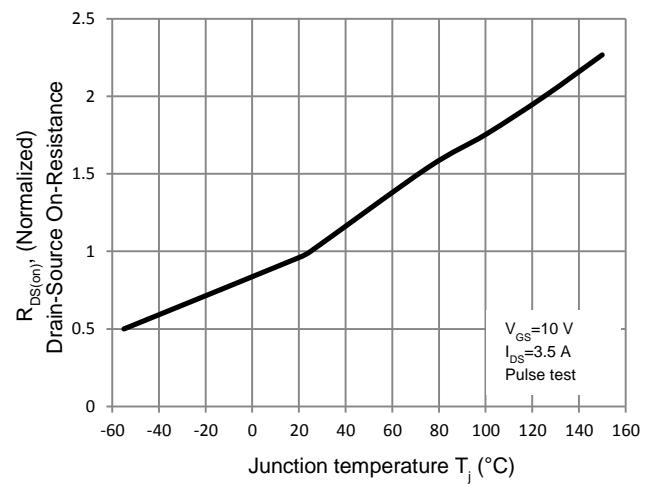
Figure 7. Capacitance Characteristics

$C_{iss} = C_{gs} + C_{gd}$ (C_{ds} = shorted)
$C_{oss} = C_{ds} + C_{gd}$
$C_{rss} = C_{gd}$

Notes:
f = 1 MHz
V_{GS}=0 V
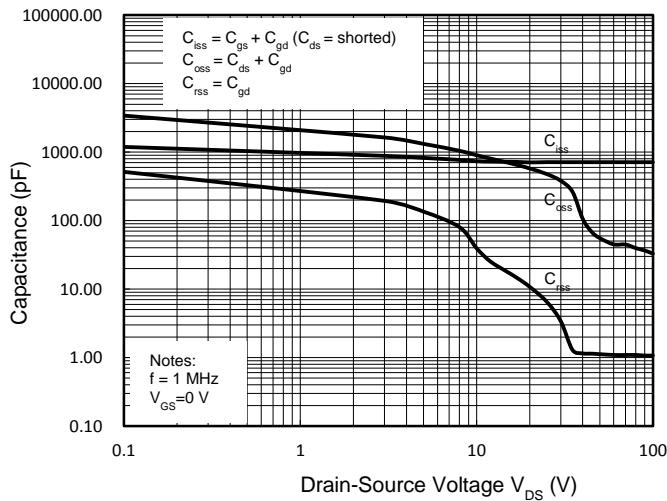
Figure 8. Gate Charge Characteristics

V_{DS}=120V V_{DS}=480V

I_D = 3.5A
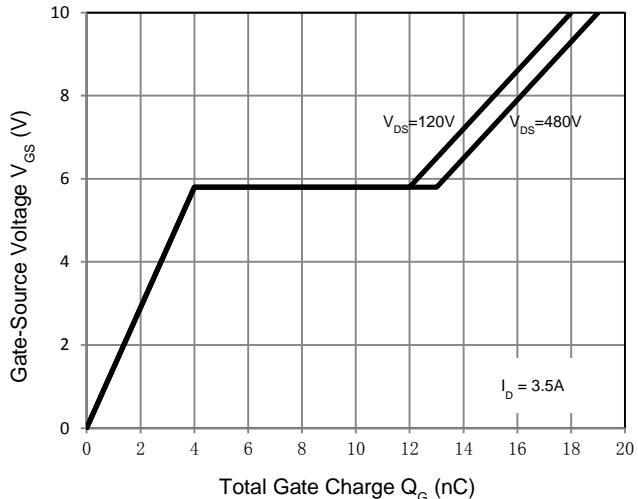
Figure 9. Maximum Safe Operating Area

Limited by $R_{DS(on)}$

10us
100us
1ms
DC

Notes:
T_c = 25°C
T_j = 150°C
Single Pulse
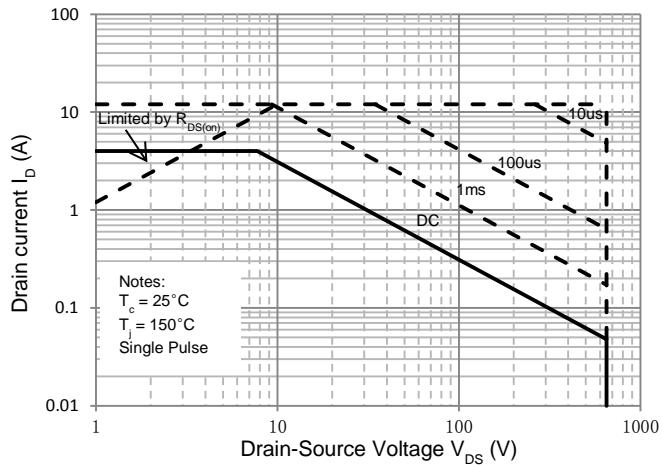
Figure 10. Power Dissipation vs. Temperature
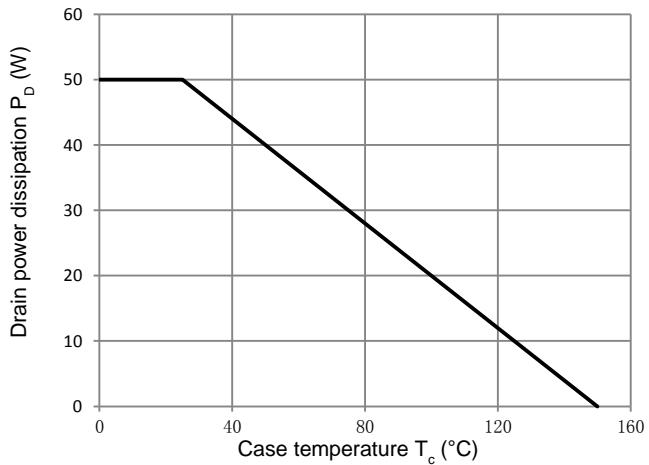
Figure 11. Transient Thermal Response Curve

In descending order
D=0.7, 0.5, 0.3, 0.1, 0.05, 0.02, 0.01, single pulse

P_{DM}
t
Duty = t/T
$Z_{\theta JC}$(t)=1.5°C/W Max.
T
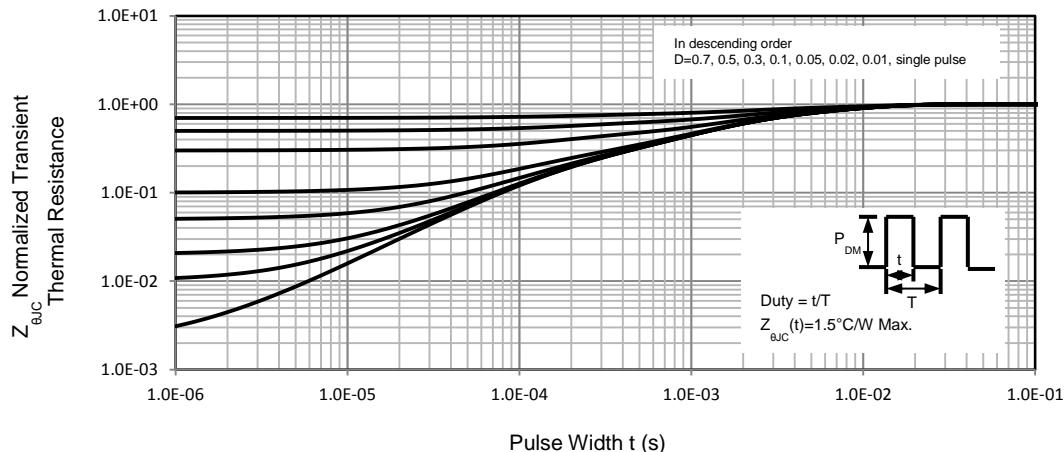
Gate Charge Test Circuit & Waveform
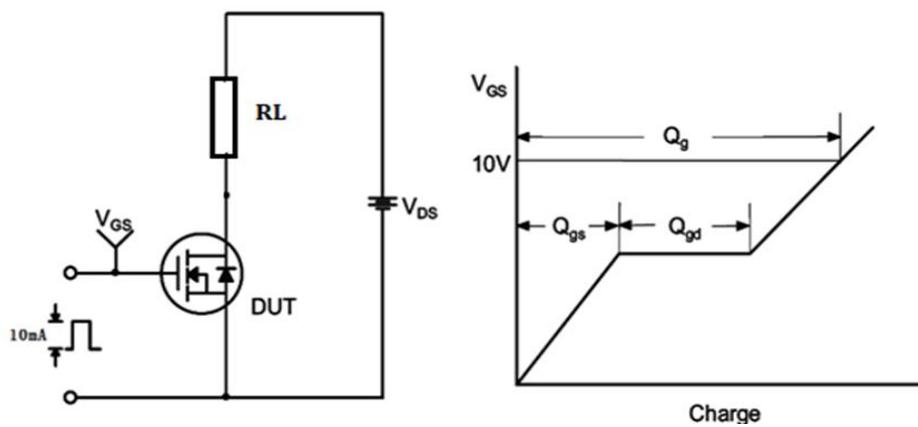
Switching Test Circuit & Waveforms
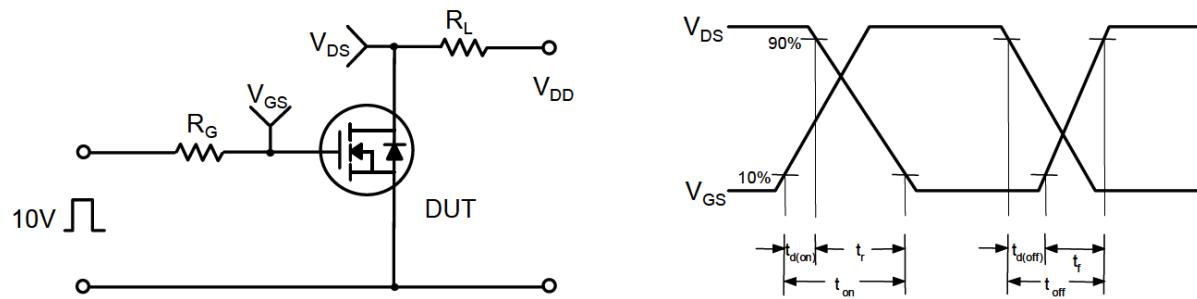
Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AR} = 1/2 \, LI_{AR}^2$$
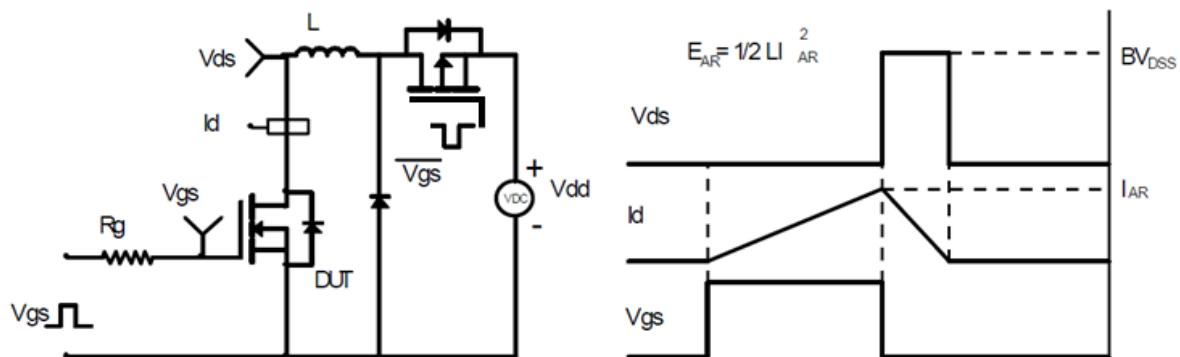
Mechanical Dimensions for TO-220
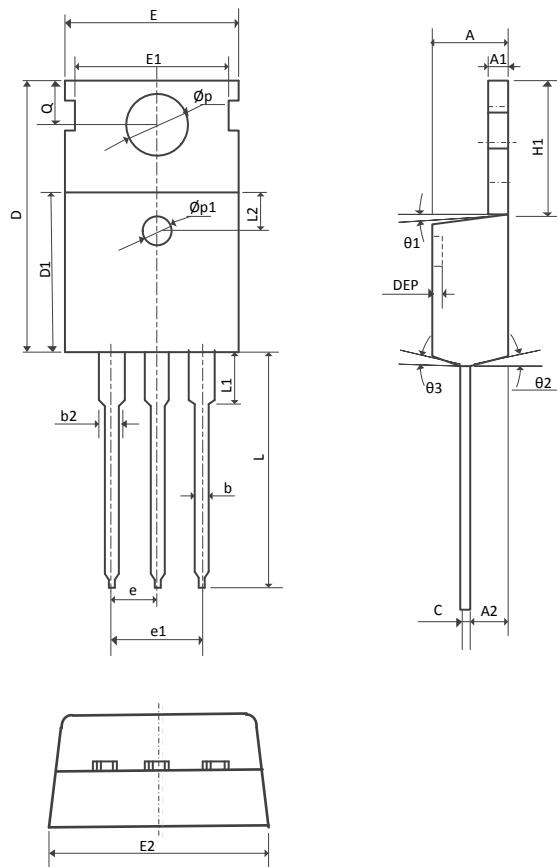
SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.40	4.57	4.70	0.173	0.180	0.185
A1	1.27	1.30	1.37	0.050	0.051	0.054
A2	2.35	2.40	2.50	0.091	0.094	0.098
b	0.77	0.80	0.90	0.030	0.031	0.035
b2	1.17	1.27	1.36	0.046	0.050	0.054
c	0.48	0.50	0.56	0.019	0.020	0.022
D	15.40	15.60	15.80	0.606	0.614	0.622
D1	9.00	9.10	9.20	0.354	0.358	0.362
DEP	0.05	0.10	0.20	0.002	0.004	0.008
E	9.80	10.00	10.20	0.386	0.394	0.402
E1	–	8.70	–	–	0.343	–
E2	9.80	10.00	10.20	0.386	0.394	0.401
Øp1	1.40	1.50	1.60	0.055	0.059	0.063
e	2.54BSC			0.1BSC		
e1	5.08BSC			0.2BSC		
H1	6.40	6.50	6.60	0.252	0.256	0.260
L	12.75	13.50	13.65	0.502	0.531	0.537
L1	–	3.10	3.30	–	0.122	0.130
L2	2.50REF			0.098REF		
Øp	3.50	3.60	3.63	0.137	0.142	0.143
Q	2.73	2.80	2.87	0.107	0.110	0.116
θ1	5°	7°	9°	5°	7°	9°
θ2	1°	3°	5°	1°	3°	5°
θ3	1°	3°	5°	1°	3°	5°

Revision History

Date	Revision	Changes
2012-5-9	2.0	First release
2012-12-10	2.1	Updated page header
2013-1-9	2.2	Fixed display error in Mac OS environment
2013-10-25	2.3	Updated the parameters of turn on/turn off, Qg, Qg chart and test condition
2013-11-6	2.4	Revised label marks of figure 4-6
2013-11-22	2.5	Changed label T_c to T_j in figure 4-6. Unified the display format of $R_{DS(on)}$. Updated figure 9-11.